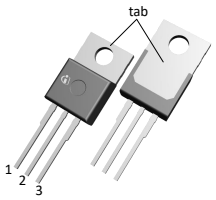
MOSFET

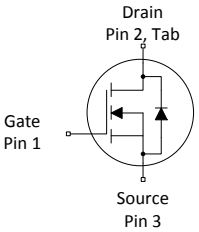
PG-TO220-3

OptiMOS™ 6 Power-Transistor, 150 V



Features

- N-channel, normal level
- Very low on-resistance $R_{DS(on)}$
- Superior thermal resistance
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

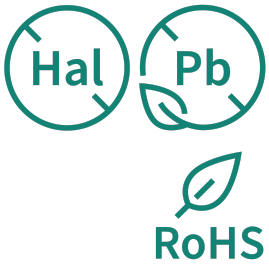


Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key performance parameters

Parameter	Value	Unit
V_{DS}	150	V
$R_{DS(on),max}$	3.8	mΩ
I_D	178	A
Q_{oss}	205	nC
Q_G	69	nC
Qrr (500A/µs)	166	nC



Type / Ordering code	Package	Marking	Related links
IPP038N15NM6	PG-TO220-3	038N15N6	-

Table of contents

1 Maximum ratings

at T_A=25 °C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Continuous drain current [1]	I_D	-	-	178 133 122 21	A	V_{GS}=10 V, T_C=25 °C V_{GS}=10 V, T_C=100 °C V_{GS}=8 V, T_C=100 °C V_{GS}=10 V, T_A=25 °C, R_{thJA}=40 °C/W [2]
Pulsed drain current [3]	$I_{D,pulse}$	-	-	712	A	T_C=25 °C
Avalanche current, single pulse [4]	I_{AS}	-	-	76	A	
Avalanche energy, single pulse	E_{AS}	-	-	503	mJ	I_D=51 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	294 3.8	W	T_C=25 °C T_A=25 °C, R_{thJA}=40 °C/W [2]
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	-

[1] Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature as specified. For other case temperatures please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

[2] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

[3] See Diagram 3 for more detailed information

[4] See Diagram 13 for more detailed information

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.51	°C/W	-
Thermal resistance, junction - ambient, 6 cm² cooling area [5]	R_{thJA}	-	-	40	°C/W	
Thermal resistance, junction - ambient, minimal footprint	R_{thJA}	-	-	62	°C/W	

[5] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

3 Electrical characteristics

at T_j=25 °C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	150	-	-	V	V_{GS}=0 V, I_D=1 mA
Gate threshold voltage	$V_{GS(th)}$	3.0	3.5	4.0	V	V_{DS}=V_{GS}, I_D=179 µA
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	µA	V_{DS}=120 V, V_{GS}=0 V, T_j=25 °C V_{DS}=120 V, V_{GS}=0 V, T_j=125 °C
Gate-source leakage current	I_{GSS}	-	10	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	3.3 3.6 4.0	3.6 3.8 4.5	mΩ	V_{GS}=15 V, I_D=76 A V_{GS}=10 V, I_D=76 A V_{GS}=8 V, I_D=38 A
Gate resistance	R_G	-	0.98	1.47	Ω	-
Transconductance	g_{fs}	65	130	-	S	$\|V_{DS}\|\geq 2\|I_D\|R_{DS(on)max}$, I_D=76 A

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Input capacitance [6]	C_{iss}	-	4900	6400	pF	V_{GS}=0 V, V_{DS}=75 V, f=1 MHz
Output capacitance [6]	C_{oss}	-	1500	2000	pF	
Reverse transfer capacitance [6]	C_{rss}	-	19	33	pF	
Turn-on delay time	$t_{d(on)}$	-	18	-	ns	V_{DD}=75 V, V_{GS}=10 V, I_D=38 A, $R_{G,ext}$=1.6 Ω
Rise time	t_r	-	17	-	ns	
Turn-off delay time	$t_{d(off)}$	-	27	-	ns	
Fall time	t_f	-	15	-	ns	

[6] Defined by design. Not subject to production test.

Table 6 Gate charge characteristics [7)]

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Gate to source charge [8)]	Q_{gs}	-	27	36	nC	V_{DD}=75 V, I_D=38 A, V_{GS}=0 to 10 V
Gate charge at threshold	$Q_{g(th)}$	-	17.3	-	nC	
Gate to drain charge [8)]	Q_{gd}	-	15.7	24	nC	
Switching charge	Q_{sw}	-	25	-	nC	
Gate charge total [8)]	Q_g	-	69	86	nC	
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	
Gate charge total, sync. FET	$Q_{g(sync)}$	-	58	-	nC	V_{DS}=0.1 V, V_{GS}=0 to 10 V
Output charge [8)]	Q_{oss}	-	205	273	nC	V_{DS}=75 V, V_{GS}=0 V

7) See "Gate charge waveforms" for parameter definition

8) Defined by design. Not subject to production test.

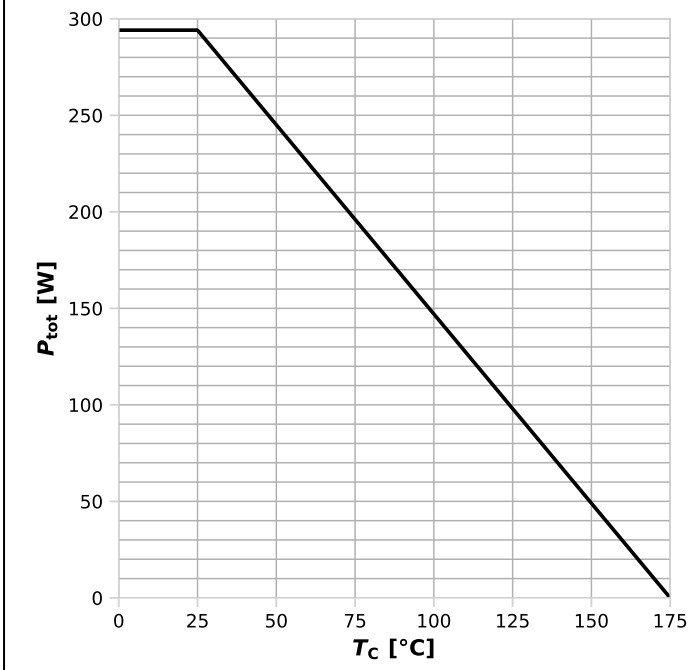
Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	173	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	712	A	
Diode forward voltage	V_{SD}	-	0.89	1.0	V	V_{GS}=0 V, I_F=76 A, T_j=25 °C
Reverse recovery time [9)]	t_{rr}	-	39	78	ns	V_R=75 V, I_F=38 A, di_F/dt=500 A/µs
Reverse recovery charge [9)]	Q_{rr}	-	166	332	nC	
Reverse recovery time [9)]	t_{rr}	-	33	66	ns	V_R=75 V, I_F=38 A, di_F/dt=1000 A/µs
Reverse recovery charge [9)]	Q_{rr}	-	272	544	nC	

9) Defined by design. Not subject to production test.

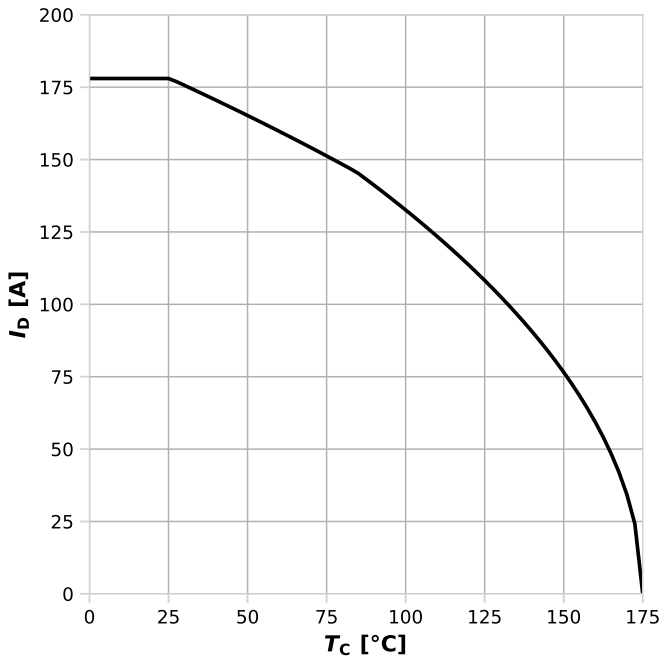
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



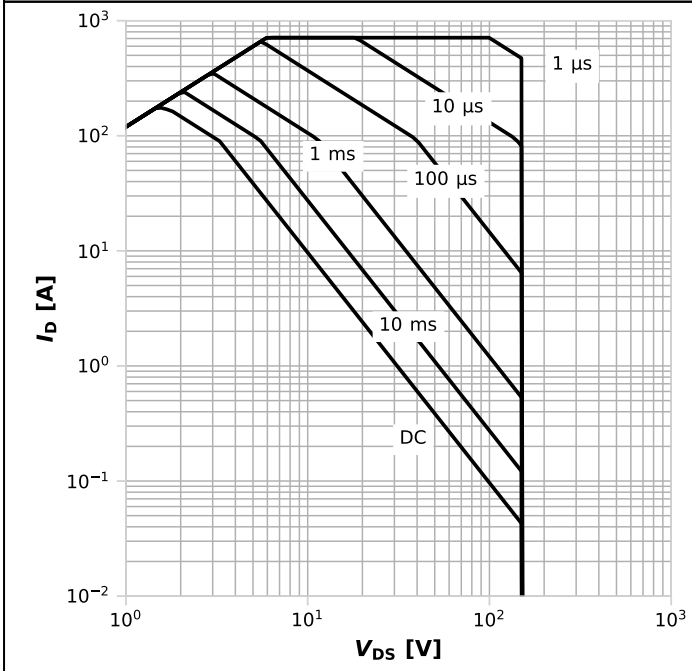
P_{tot}=f(T_C)

Diagram 2: Drain current



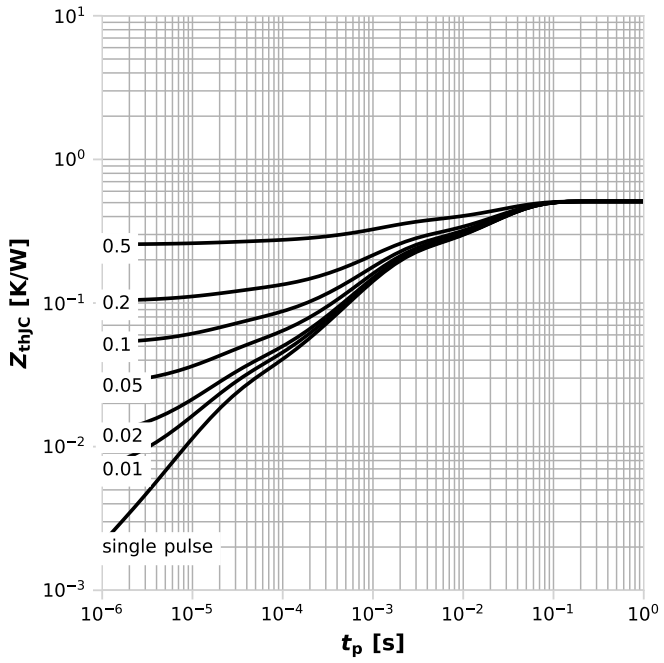
I_D=f(T_C); V_{GS}≥10 V

Diagram 3: Safe operating area



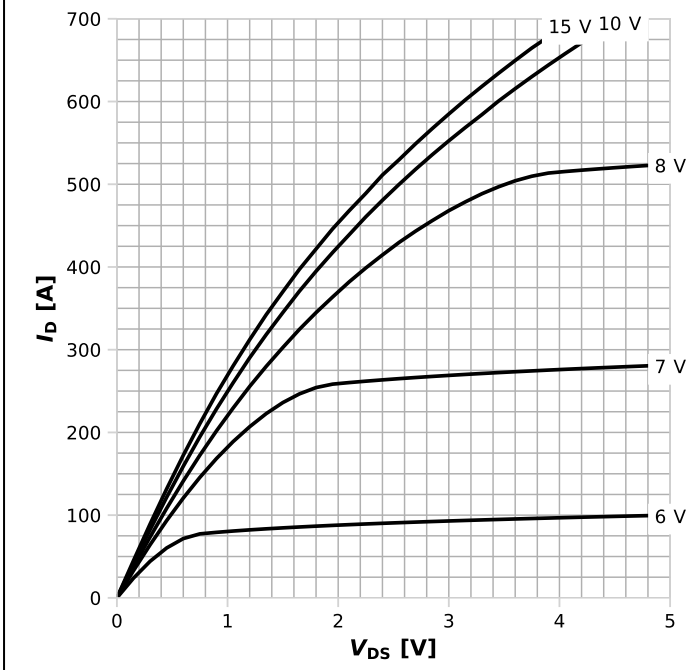
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



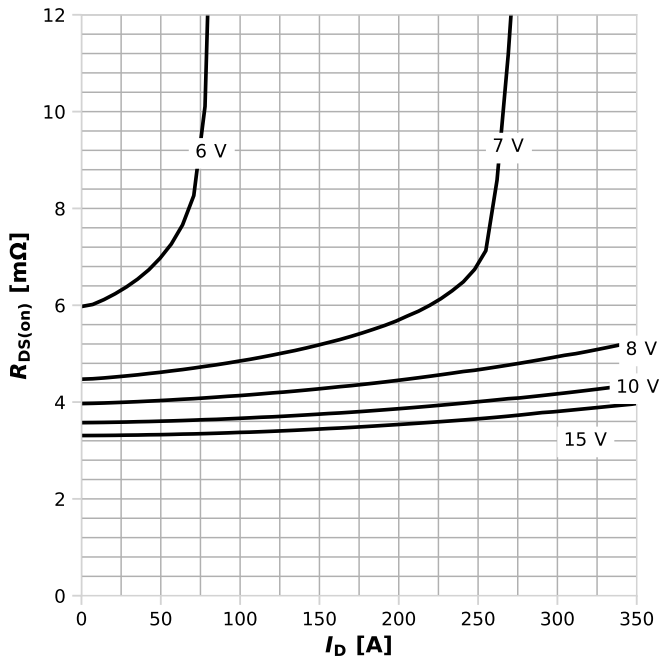
Z_{thJC}=f(t_p); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



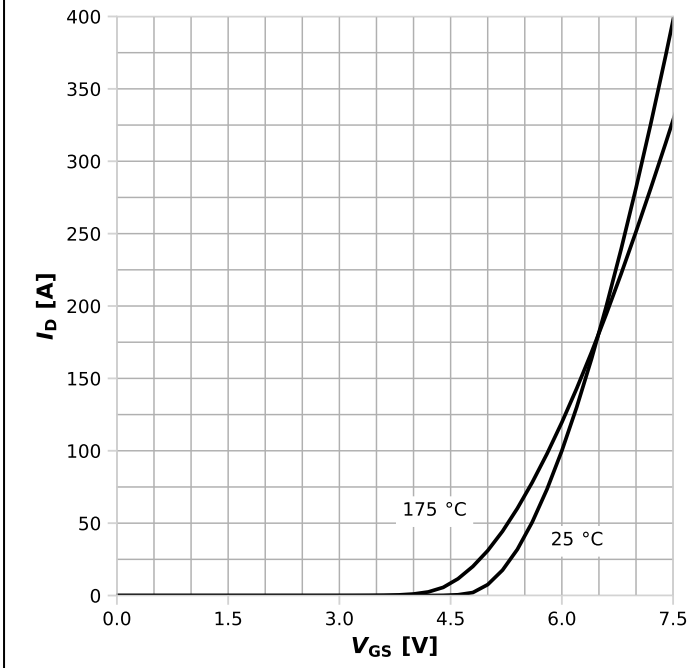
$I_D=f(V_{DS})$, $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



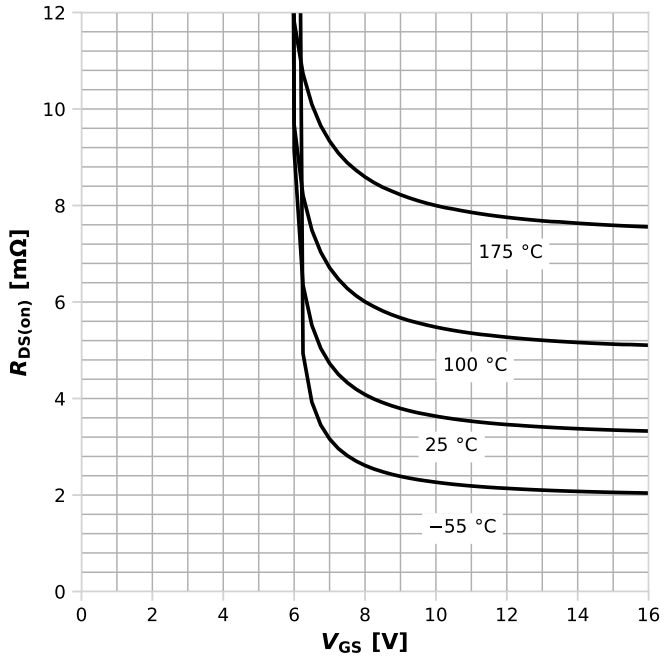
$R_{DS(on)}=f(I_D)$, $T_j=25$ °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



$I_D=f(V_{GS})$, $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



$R_{DS(on)}=f(V_{GS})$, $I_D=76$ A; parameter: T_j

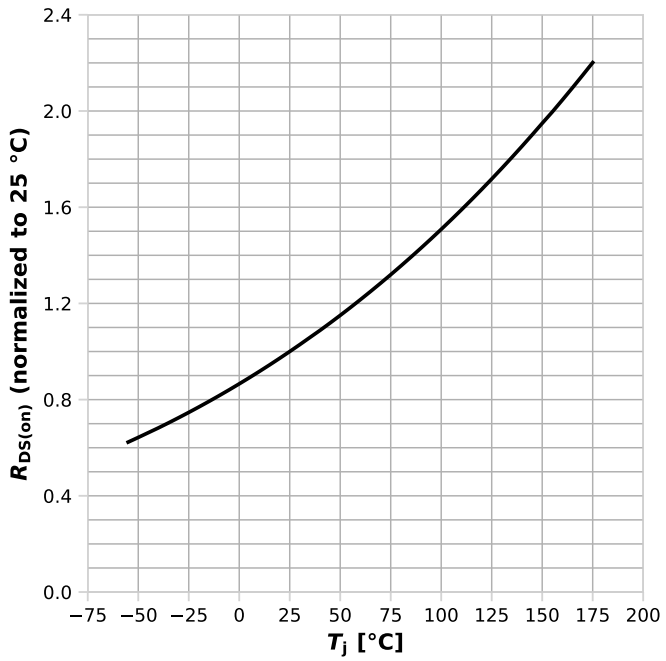
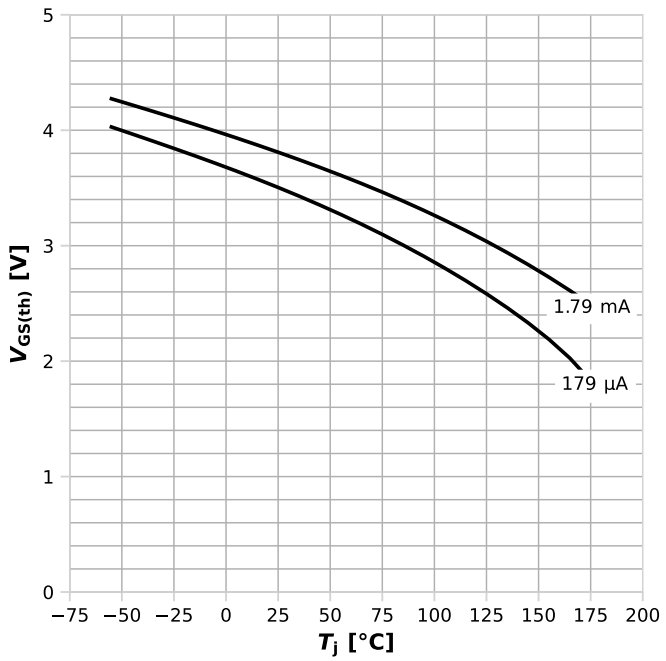
Diagram 9: Normalized drain-source on resistance	Diagram 10: Typ. gate threshold voltage
	
$R_{DS(on)}$=f(T_j), I_D=76 A, V_{GS}=10 V	$V_{GS(th)}$=f(T_j), V_{GS}=V_{DS}; parameter: I_D

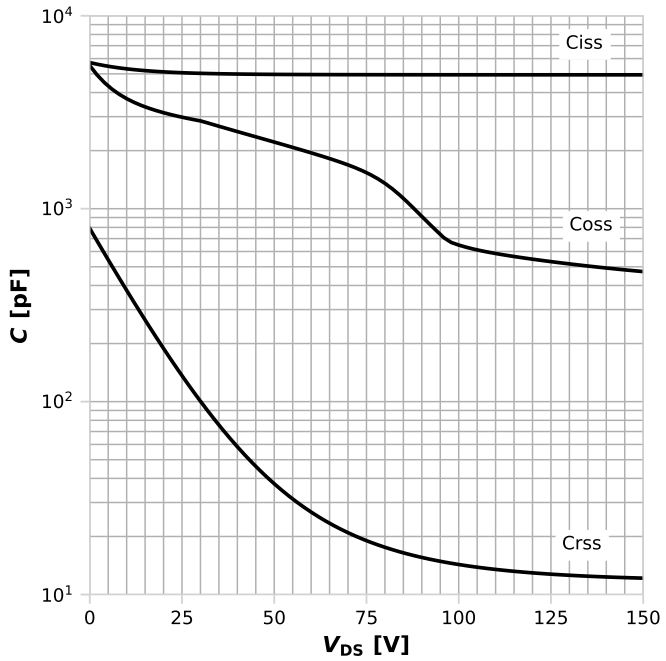
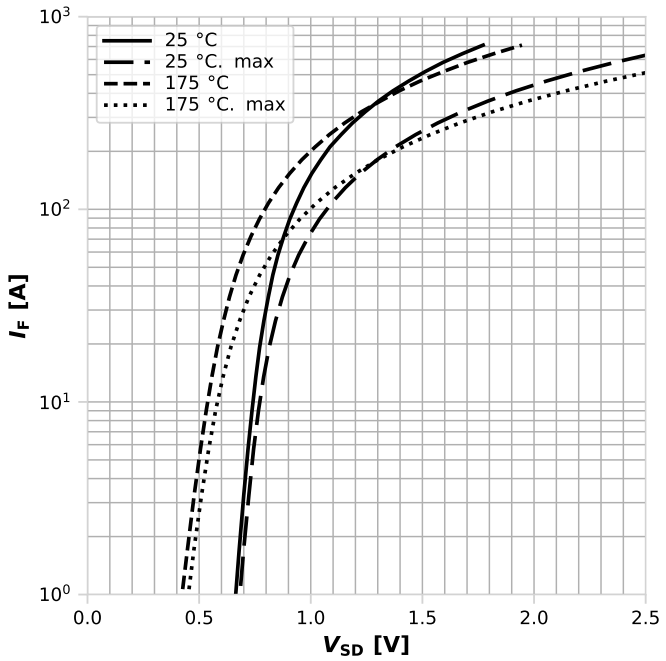
Diagram 11: Typ. capacitances	Diagram 12: Forward characteristics of reverse diode
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	I_F=f(V_{SD}); parameter: T_j

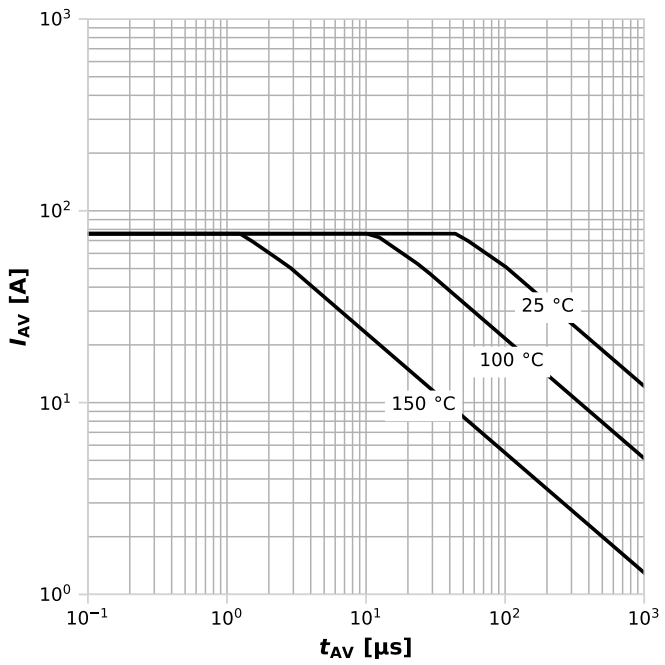
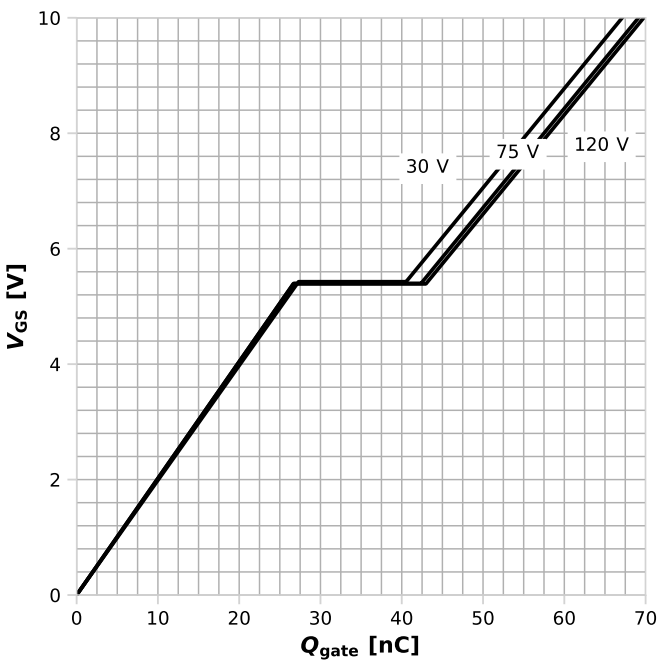
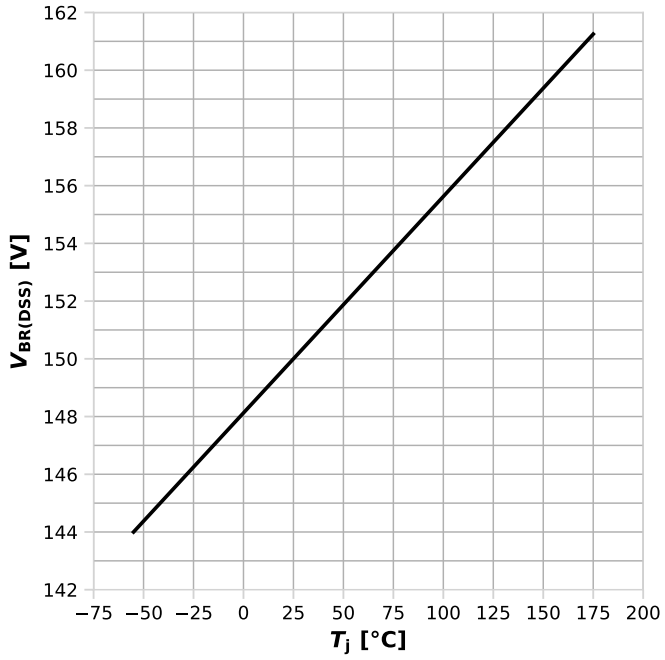
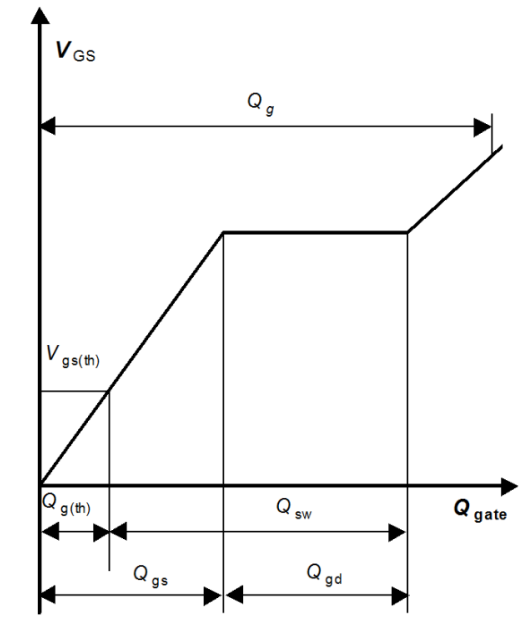
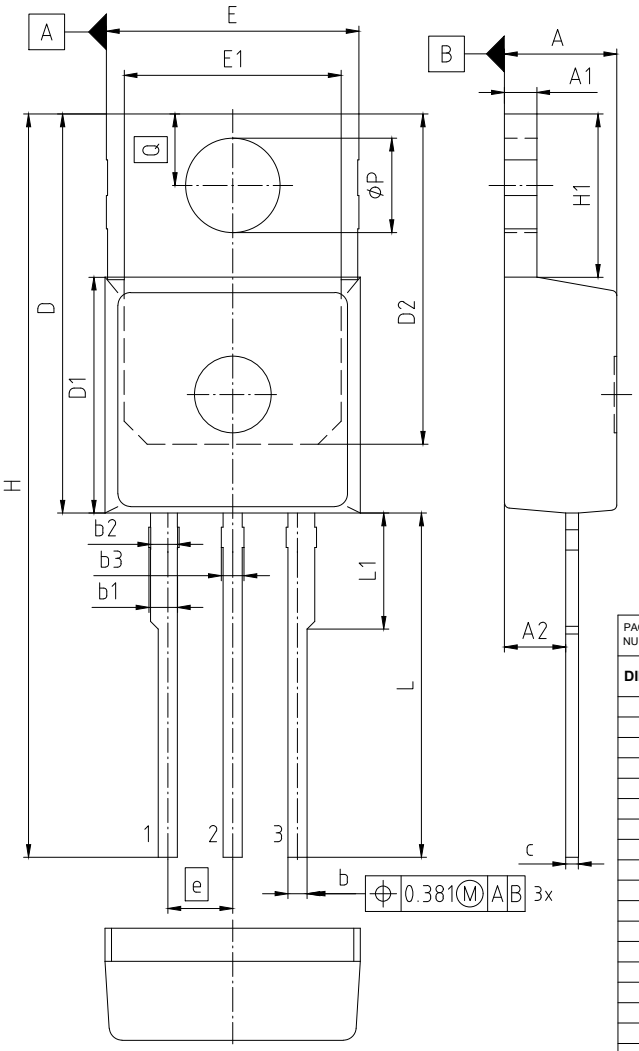
Diagram 13: Avalanche characteristics	Diagram 14: Typ. gate charge
	
I_{AS}=f(t_{AV}); R_{GS}=25 Ω; parameter: $T_{j,start}$	V_{GS}=f(Q_{gate}), I_D=38 A pulsed, T_j=25 °C; parameter: V_{DD}

Diagram 15: Min. drain-source breakdown voltage	Gate charge waveforms
	
$V_{BR(DSS)}$=f(T_j); I_D=1 mA	-

5 Package outlines



NOTES:
DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS
GATE BURRS ARE LESS THAN 0.5 mm

PACKAGE - GROUP NUMBER:	PG-TO220-3-U04	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.30	4.57
A1	1.17	1.40
A2	2.15	2.72
b	0.65	0.86
b1	0.95	1.40
b2	0.95	1.15
b3	0.65	1.15
c	0.33	0.60
D	14.81	15.95
D1	8.51	9.45
D2	12.19	13.10
E	9.70	10.36
E1	6.50	8.60
e	2.54	
N	3	
H	28.65	29.65
H1	5.90	6.90
L	13.00	14.00
L1	4.35	4.80
øP	3.55	3.89
Q	2.60	3.00

Figure 1 Outline PG-TO220-3, dimensions in mm

Revision history

IPP038N15NM6

Revision 2024-12-09, Rev. 1.0

Previous revisions

Revision	Date	Subjects (major changes since last revision)
1.0	2024-12-09	Release of final datasheet

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